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SPECIAL REPORT

LOSS IN VOLUME OF WHITE PINE IN NEW HAMPSHIRE CAUSED BY THE WHITE PINE WEEVIL

by

W. E. Waters, T. McIntyre and D. Crosby

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CONTENTS

	Page
SUMMARY	1
INTRODUCTION	1
PROCEDURE	2
THE LOSS	3
Pole-timber Trees -- cubic volume	3
Saw-timber Trees	4
Saw-log material -- board-foot volume	4
Material other than saw-logs -- cubic volume	7
DISCUSSION	7

SPECIAL REPORT

LOSS IN VOLUME OF WHITE PINE IN NEW HAMPSHIRE CAUSED BY THE WHITE PINE WEEVIL

W.E. Waters, T. McIntyre, and D. Crosby

SUMMARY

A field study was conducted in New Hampshire during October and November 1952 to determine the loss in merchantable volume of white pine attributable to the white pine weevil, Pissodes strobi (Peck). There is a real and sizable loss which seriously reduces the productive capacity of the pine timber crop.

The average loss in percent and actual volume of pole- and saw-timber trees (up to 24 inches d.b.h.) is given by diameter class. In pole-size trees (5.0 to 8.9 inches d.b.h.) it is 13 percent (cubic volume). In saw-timber trees (9.0 inches d.b.h. and over) the loss averages 40 percent in the saw-log portion (board-foot volume) and 70 percent in the portion above saw-log limits of merchantability (cubic volume). These percentage losses represent 450,000 cords or 35 million cubic feet of potential merchantable volume in pole-timber trees, 2.16 billion board feet in the saw-log portion of saw-timber trees, and 1,486,000 cords or 116 million cubic feet for material other than saw-logs. These volume losses are computed from net merchantable volumes determined by a forest inventory of New Hampshire in 1948 by the U. S. Forest Service.

INTRODUCTION

The white pine weevil, a native insect, is the most serious insect pest of eastern white pine. While rarely, if ever, the direct cause of a tree's death, it can render one partially or completely unmerchantable. Crooked or forked stems, resulting from the characteristic killing of the leaders of attacked trees for a length generally of two or three whorls and the assumption of dominance by one or more lateral branches, are a common sight throughout the range of white pine in the Northeast. Damage is particularly severe in pure plantations and old field stands. The depredations of this insect have materially influenced planting programs, management practices, and utilization of white pine in all states in the region.

The total loss in value of pine timber due to the weevil includes losses both in volume and in quality. The loss in volume is of two sorts: (1) loss due to decrease in merchantable height and increased taper, and (2) loss due to defects within the merchantable length. Quality loss is occasioned primarily by degrade of sawn lumber and by utilization of pine for less valuable products. In an economic sense these losses apply only to the trees and stands in the merchantable size classes. Weevil damage to smaller trees in natural stands and plantations represents a potential financial loss, however,

which in the case of plantations is particularly important, yet difficult to appraise, as added investments of funds and manpower have been made.

The scope of this study, as an integral part of an overall appraisal of the economic importance of the white pine weevil in the Northeast, was restricted to the first phase of the problem -- determination of the direct loss in merchantable volume of white pine caused by this insect.

Special appreciation is due Royce H. Hutchins, New Hampshire Department of Agriculture, for assistance in the field work. Grateful acknowledgment is made to the Forest Survey staff and C. A. Bickford, Northeastern Forest Experiment Station, U.S. Forest Service; Robert P. Holdsworth, Department of Forestry, University of Massachusetts; E.V. Zumalt, H.J. Lutz, and D.M. Smith, Yale School of Forestry; J.G. Conklin, State Entomologist, New Hampshire.

PROCEDURE

For the purposes of this study it was desirable that a fairly large area be covered where white pine types were fully represented and a maximum of basic data, including a complete forest inventory, was available. The state of New Hampshire, where a forest survey was completed in 1948 by the Northeastern Forest Experiment Station, admirably fitted these specifications.

The field data for this study were taken from 102 sample plots initially established for the forest survey in New Hampshire.[1] These plots, first located in an unbiased manner on aerial photos, were permanently marked in the field and spotted on U.S.G.S. topographic maps with a detailed sketch map of each. All were located in pole- and saw-timber stands in white pine (75 percent or more white pine) and white pine-hardwood (50-74 percent white pine) types. The plots were scattered from the Massachusetts state line northward to Littleton, approximately 125 miles, and the number of plots in any given area was in approximate proportion to the occurrence of the two pine types in that area. All poles (5.0 to 8.9 inches) were measured on a 1/5-acre plot and saw-timber trees (9.0 inches and over) on a 1/2-acre plot with radii of 52.7 and 83.3 feet respectively from the same center. Supplementary observations and measurements of white pine in the larger size classes were made in the vicinity of Amherst, Mass. and at the Yale Forest near Keene, N.H.

The merchantability standards followed in this study were those described in the Forest Survey Field Manual -- Northeastern States. Diameter at breast height was measured to the nearest inch. Trees forking below this point were tallied as separate stems with the diameter 3 1/2 feet above the fork measured or estimated for each. Merchantable height was measured to the nearest 4 feet from a 1-foot stump to a point where utilization was limited by excessive branching, forks, or deformities or an estimated diameter

[1] Thirty-two plots were cut over or not found -- substitute plots were taken in adjacent pine stands of similar type and stand condition.

inside bark of 4 inches. Deductions for defects within the merchantable length due to the weevil were made on the saw-log portion of saw-timber trees only, i.e. from the 1-foot stump to a 6-inch d.i.b. top or a point where utilization was limited by large branches, etc. These deductions were recorded as percent of gross board-foot volume of 8-foot sections and the total cull for a tree was computed by reference to a table for white pine listing the percentage of total board-foot volume in successive 4-foot sections of trees in different merchantable height classes. Volume losses due to causes or agencies other than the weevil were not recorded. No cull deductions were made for cubic-foot volume, i.e. on pole-timber trees or that portion of saw-timber trees above the 6-inch and below the 4-inch top, as such volume is not ordinarily decreased by weeviling (sound) defects.

THE LOSS

Pole-timber Trees

The merchantable volume loss in pole-size trees is due to loss in merchantable height alone. The merchantable height curves for weeviled and non-weeviled trees are included in Fig. 1, and the calculated average values for each diameter class are given in Table 1 with the height loss in feet and percent.

Table 1. Merchantable height of weeviled and non-weeviled pole-timber trees -- New Hampshire 1952

DBH	Average MH- 4" top		Loss in ft.	Loss in percent
	Non-weeviled	Weeviled		
5	14	12	2	14
6	20	15	5	25
7	24	18	6	25
8	29	21	8	28
9*	33	24	9	27

*8.5-8.9 inches incl.

The merchantable volumes of the average (regression) trees in each diameter class are listed in Table 2. The difference, in cubic feet and percent, is the average loss in volume of weeviled trees. This loss is shown graphically in Fig. 2.

Table 2. Merchantable volume of weeviled and non-weeviled pole-timber trees -- New Hampshire 1952.

D.B.H.	Volume-cubic feet* Non-weeviled	Weeviled	Volume loss cu.ft.	Volume loss percent
5	1.50	1.31	0.19	13
6	2.68	2.24	0.44	16
7	4.18	3.47	0.71	17
8	6.05	4.99	1.06	18
9	8.26	6.85	1.41	17
			Average	17 percent

*From Mensuration, tree studies, volume tables Memo to files, C. A. Bickford, Northeastern Forest Experiment Station, Upper Darby, Pa.

As shown above the average merchantable volume loss in weeviled pole-timber trees is 17 percent. However, of the 1,152 pole-timber sample trees just 872 or 76 percent are weeviled. The average volume loss for all trees in this size class, therefore, is 13 percent.

The Forest Survey estimated a total net merchantable volume of approximately 3 million cords of white pine in pole-timber trees in New Hampshire in 1948[1]. The hypothetical volume without loss due to weevil damage, therefore, was 3.45 million cords, the 13 percent loss attributable to the weevil accounting for 450,000 cords. On the basis of 78 cubic feet per cord this loss amounts to over 35 million cubic feet merchantable volume.

Saw-timber Trees.

Board-foot volume loss in saw-timber trees results from loss in merchantable height and from deductions for defects due to the weevil within the merchantable length. There is also a loss in cubic-foot or cordwood volume from that portion of the stem above the limit of saw-log merchantability.

Saw-log material. -- The merchantable height curves of saw-timber trees to both the 4-inch and 6-inch minimum tops are shown in Fig. 1. The calculated average heights for weeviled and non-weeviled trees from these curves are given in Table 3 with the height loss in feet and percent computed from the maximum merchantable height (4-inch top) of non-weeviled trees. It is evident that few weeviled trees reach that limit of merchantability. Data for trees over 24 inches are not included, as there are so few the averages are of doubtful accuracy.

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[1] Forest statistics for New Hampshire. 1950. Forest Survey Release No. 9, Northeastern Forest Experiment Station.

Table 3. Merchantable height of weeviled and non-weeviled saw-timber trees -- New Hampshire 1952.

D.B.H.	6-inch min. top diameter Average MH		4-inch min. top diameter Average MH		Loss in feet	Loss in percent
	Non-weeviled	Weeviled	Non-weeviled	Weeviled		
9*	30	15	33	15	18	55
10	34	17	37	17	20	54
11	38	19	41	19	22	54
12	41	20	44	21	23	52
13	44	22	47	22	25	53
14	47	23	50	23	27	54
15	50	24	52	24	28	54
16	52	24	54	25	29	54
17	54	25	56	25	31	55
18	56	25	58	25	33	57
19	58	24	59	25	34	58
20	59	24	59	25	34	58
21	60	23	60	24	36	60
22	60	23	60	23	37	62
23	60	22	60	22	38	63
24	60	20	60	21	39	65

*9.0-9.4 inches incl.

The height loss increases significantly, in percentage as well as actual length, in the diameter classes over 17 inches. This is due largely to the increased proportion of completely unmerchantable trees in those larger size classes.

The pertinent board-foot volume loss data for saw-timber trees are summarized in Table 4 and are presented for visual appraisal in Fig. 3.

Table 4. Board-foot volume of weeviled and non-weeviled saw-timber trees -- New Hampshire 1952.

D.B.H.	Volume-board feet* Non-weeviled	Weeviled	Merchantable height volume loss-b.f.	"Weevil cull" volume loss-b.f.**	Total vol. loss-b.f.	Total vol. loss-%
9	30	20	10	2	12	40
10	43	29	14	3	17	40
11	56	39	17	5	22	39
12	74	50	24	6	30	41
13	97	64	33	7	40	41
14	116	79	37	9	46	40
15	141	94	47	11	58	41
16	166	109	57	13	70	42
17	196	127	69	15	84	43
18	224	144	80	17	97	43
19	254	160	94	19	113	44
20	291	179	112	21	133	46
21	327	196	131	23	154	47
22	365	209	156	24	180	49
23	405	223	182	26	208	51
24	442	232	210	27	237	54

Average 46%

* From Form-class volume tables for estimating board-foot content of northern conifers by C.A. Bickford. Sta. Paper No. 38. Northeastern Forest Exp. Sta.

** The deduction for cull due to weeviling is 11.6% -- consistent within a narrow range over all diameter classes (11.6 ± 0.3%)

The volume loss also increases noticeably in the diameter classes over 17 inches, particularly in board-foot terms. This is a critical result probably of high-grading practices, selection of the better stands and trees for cutting and disregard for the ill-formed trees returning less profit. Large pine of good form and height were observed infrequently in this study.

Form-class 70 was assumed for both weeviled and non-weeviled trees. Generally, weeviled trees have more taper than non-weeviled trees, however, so the volumes listed in Table 4 are slightly high for the former and low for the latter. The differences in average volumes between the two classes of trees are on the conservative side, therefore. The effect of this on the total percent loss would be relatively slight, however.

Of 2,465 sample saw-timber trees 2,142, or 87 percent, are weeviled. As the average board-foot volume loss for the weeviled trees is 46 percent (Table 4), the average loss for all saw-timber trees, non-weeviled and weeviled, is 40 percent.

The Forest Survey in New Hampshire revealed an estimated net volume of 3.24 billion board feet in saw-timber trees in 1948.[1] The hypothetical volume

[1] Forest statistics for New Hampshire. Op. cit.

excluding loss from weevil damage would have been 5.40 billion b.f., the 40 percent loss due to the weevil amounting to 2.16 billion b.f. merchantable volume.

The deduction applied by the Forest Survey for sound cull in white pine of saw-timber size in New Hampshire was 13 percent. The deduction for defects within the merchantable length due to weeviling (sound cull) determined by the present study is 11.6 percent for weeviled trees alone or 10 percent over all saw-timber trees.

Material other than saw-logs. -- There is a further volume loss, small but nonetheless important, in trees of saw-timber size. The portion above the saw-log limits (excluding limbs) which is merchantable for cordwood or other purposes is decreased by weeviling. In some non-weeviled trees this section is 20 feet or more in length, and for all non-weeviled trees it averages 2.3 feet. In weeviled trees it is rarely over 8 feet and averages 0.5 foot. This merchantable length in non-weeviled trees normally decreases directly as d.b.h. increases, and in the larger diameter classes it approaches zero as the 6-inch minimum top diameter is attained less frequently (see Fig.1). When weeviled, few trees in any diameter class are merchantable to even the 6-inch top.

The difference between 2.3 and 0.5 feet represents a loss of 78 percent in merchantable length and approximately 80 percent in volume for weeviled trees. Over all trees, weeviled and non-weeviled, this is a loss of 70 percent.

In 1948 the Forest Survey in New Hampshire estimated a total of 637,000 cords in the top portion of white pine saw-timber trees. There was, therefore, a potential volume of 2,123,000 cords, the 70 percent loss due to the weevil amounting to 1,486,000 cords. The hypothetical loss in cubic volume (78 cubic feet per cord) is approximately 116 million cubic feet.

DISCUSSION

White pine is one of the most important commercial tree species in the Northeast. In New England, which includes most of the natural white pine region, it is by far the most important lumber tree and provides the major supply of raw material for the wooden box industry and other products as well. It is estimated that the total economic value of white pine to New England alone ranges from $70 million to $80 million a year.[1] Yet its potential productive capacity and economic value are far from realized.

Destructive cutting practices have seriously depleted the reserve of standing white pine in this region. Less evident but equally important, perhaps, is the considerable loss in merchantable volume caused by the white pine weevil. Damage by this insect has been generally accepted as an unavoidable devilment of Nature -- which in a sense it is. As the present commodity drain on white pine exceeds growth -- by more than 35 percent in saw-timber trees in New Hampshire -- there is approaching the critical point where conservation and protection of the timber crop must be made a part of white pine management

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[1] Eastern white pine -- Nature's gift to New England. Monthly Review 32 (9). Fed. Res. Bank of Boston.

if the lumber and allied industries are to depend on it as a continuing source of supply. More positive action might be taken with regard to the weevil, for example, if reliable quantitative data on the losses due to this pest were made available. The present study and report is the result of a cooperative effort for that purpose.

The sample plots for this study extend across a large part of the white pine region and provide an unbiased sample of pine types. The merchantability standards used (from the Forest Survey Field Manual -- Northeastern States) represent the average utilization criteria for the entire region and, while the percentage losses given in this report may be either high or conservative for any local area, they are a reasonably accurate estimate of the losses over the entire state. Moreover, these estimated average losses may be a close approximation of those elsewhere in the white pine region.

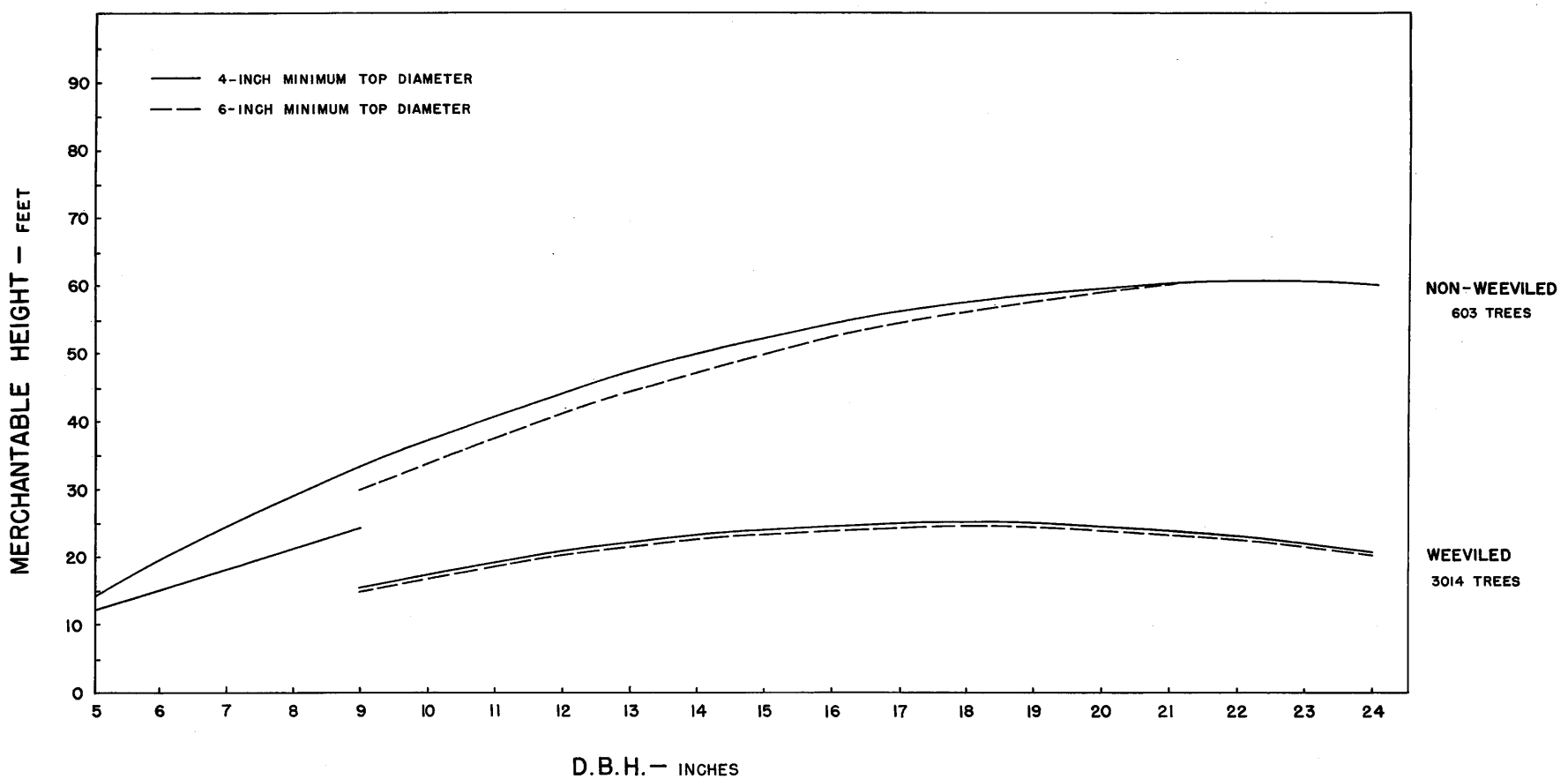

FIG. 1. MERCHANTABLE HEIGHT OF WEEVILED AND NON-WEEVILED WHITE PINE IN NEW HAMPSHIRE — 1952.

VOLUME LOSSES IN WEEVILED WHITE PINE

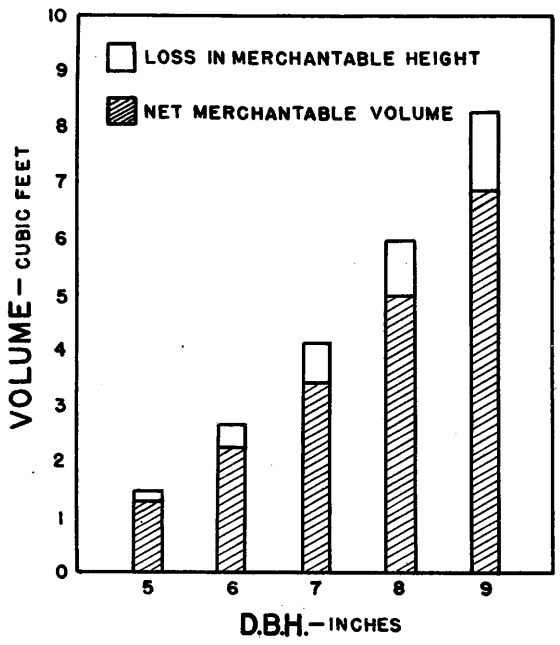

FIG. 2. LOSS IN CUBIC-FOOT VOLUME OF POLE-TIMBER TREES

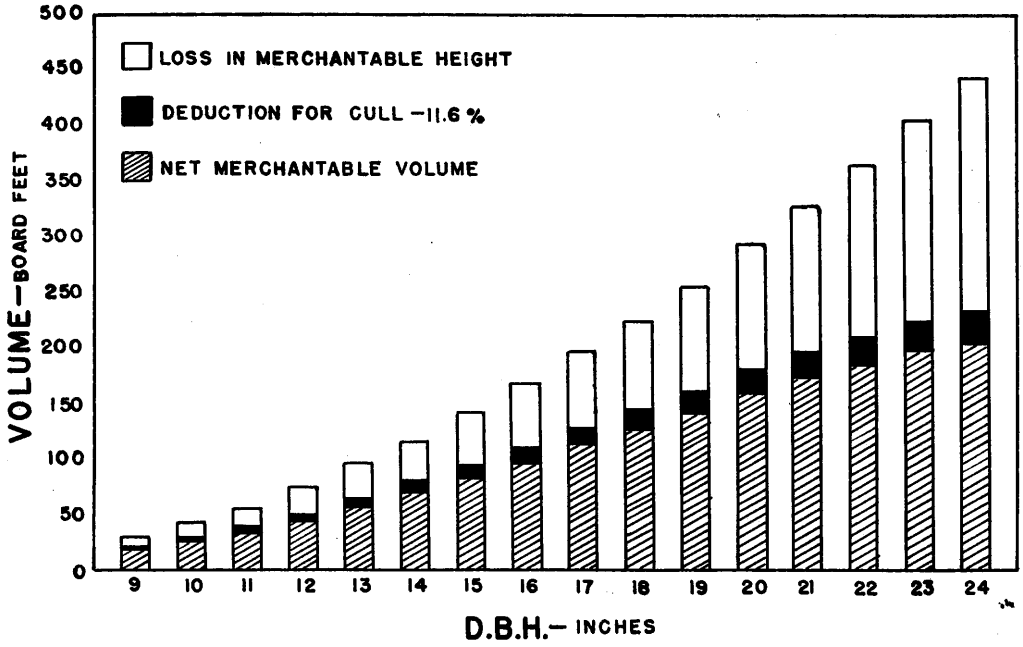

FIG. 3. LOSS IN BOARD-FOOT VOLUME OF SAW-TIMBER TREES